INSTITUTO FEDERAL DE
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Mathematical Modeling Fluid Determination in River Bed Trough: Search based drag mud deposited in the sweet River bed

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ABSTRACT

This document presents the formatting model to be utilized in papers to be sent to Research & Development in Production Engineering. Mathematical modeling Fluid determination in bed River Trough: Search based drag mud deposited in the sweet River bed.
Keywords: Modeling Mathematical, Fluid, Drag, River

Introduction

The complexity of the movement of fluids are expressed in variables difficult to understand and multivariate analysis, given the various parameters and concepts involved in modeling. Its analysis is mathematically very complex to have different densities. Thus, to analyze the motion of a fluid, often resorts to simplifications in ways to reduce its complexity. The most common simplification is to consider the movement (flow) of an ideal fluid. An ideal fluid is an incompressible fluid (its density does not vary), which has no viscosity (). The compressible liquids are few, so that in general can be considered incompressible. In this model proposed for the Samarco Mining dam mud have to take into account the internal friction of a fluid (viscosity) may lead to shear stresses when the fluid flows in a river or flows around an obstacle. But this shear stress can be neglected when they are smaller compared to the pressure differences arising forces or gravity. Different types of flow can be seen in the frame:

Type of Fluid		According to the surface	
Viscous Fluid	**Not viscous Fluid**	**Flow Internal**	**External flow**
Laminar flow	Turbulent flow (turbidity)		

Frame 1: Developed for this work

(1) Capes researcher Professor partnership co IFES Federal Institute of Technology and visiting Foreign institutions. Development of mathematical models applied to events.

2. Format developed for this work proposal

The figure below describes the planned training for this research, modeling and leaving mud drag the assumption by turbidity in the lower riverbed.

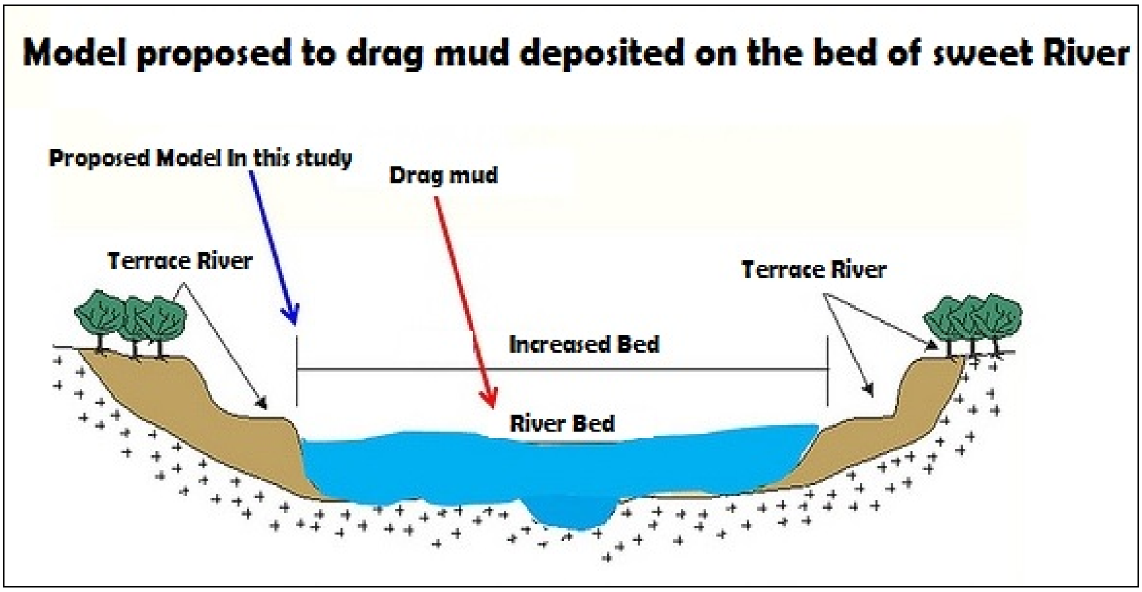

Figure 1: River bed diagrams - Adapted for this research: http://ecan.govt.nz/
Source: New Zealand Govt - Use the following diagrams to assist you in understanding the definition of a "bed". "Bed" means in relation to any river.

For the assumptions above, the mass enters into chain Bed, in a region where the area is at a certain time interval is equal to the mass which comes out of Rio trough in the same time slot but in another region where the area is . In this case we can write:

$$dm_1 = dm_2 \Rightarrow p dV_1 = p dV_2 \qquad (1)$$

The volume of fluid that enters and that leaves can be determined by the speed of fluid movement, then:

$$dV_1 = A_1 \, . \, v_1 \, . \, dt . dV_2 = A_2 \, . \, v_2 \, . dt \qquad (2)$$

So, as $pdV_1 = pdV_2 \Rightarrow dV_1 = dV_2$ So $A_1 \, . \, v_1 \, . \, dt = A_2 \, . \, v_2 \, . \, dt$

Eliminating **dt**, we get: $A_1 \, . \, v_1 = A_2 \, . \, v_2$ **(3)**

The parameter called the volumetric flow, is defined by:

$$R_v = \frac{dV}{dt} = A . v \qquad (4)$$

It is the amount of charge that passes through a cross-section of the trough per unit time. The mass flow is the mass change rate per unit time and is defined as the product of the volumetric flow density:

$$R_m = \frac{dm}{dt} = \rho \cdot A \cdot u \qquad (5)$$

In the case of a compressible fluid, the density may vary along the flow. In this case, the continuity equation becomes:

$$\rho_1 \cdot A_1 \cdot u_1 = \rho_2 \cdot A_2 \cdot u_2 \qquad (6)$$

3. Using the Bernoulli equation for modeling drag

As regards the variation within a fluid, is only applicable when the fluid is static, which can lead us to think, how to vary the pressure inside a moving fluid in the river (originating mud Samarco Mining dam) .

The answer to this question can be deduced from the continuity equation and is called Bernoulli equation exposed:

The original form, which is for an incompressible flow in a uniform gravitational field (as found in small elevations in the earth), is:

$$\frac{v^2}{2} + gh + \frac{p}{\rho} = \text{constante} \quad \textbf{ou} \quad \frac{\rho\, v^2}{2} + \rho g h + p = \text{constante} \qquad (7)$$

u = Fluid velocity along the river

g = Acceleration of gravity

h = Height in relation to a reference

p = Pressure along path

ρ = Specific mass of the fluid (mud)

The following conventions must be satisfied for the equation applies:

- flow without viscosity ("friction" internal = 0)
- flow in steady state
- incompressible flow (ρ constant throughout the flow)

• Generally, equation applies to a duct as a whole. For potential flow of constant density, it applies to the entire flow field.

The reduction in pressure which occurs simultaneously with an increase in speed as predicted by the equation, is often called the Bernoulli principle.

The equation is dedicated to Daniel Bernoulli although it was first presented the way it is there by Leonhard Euler.

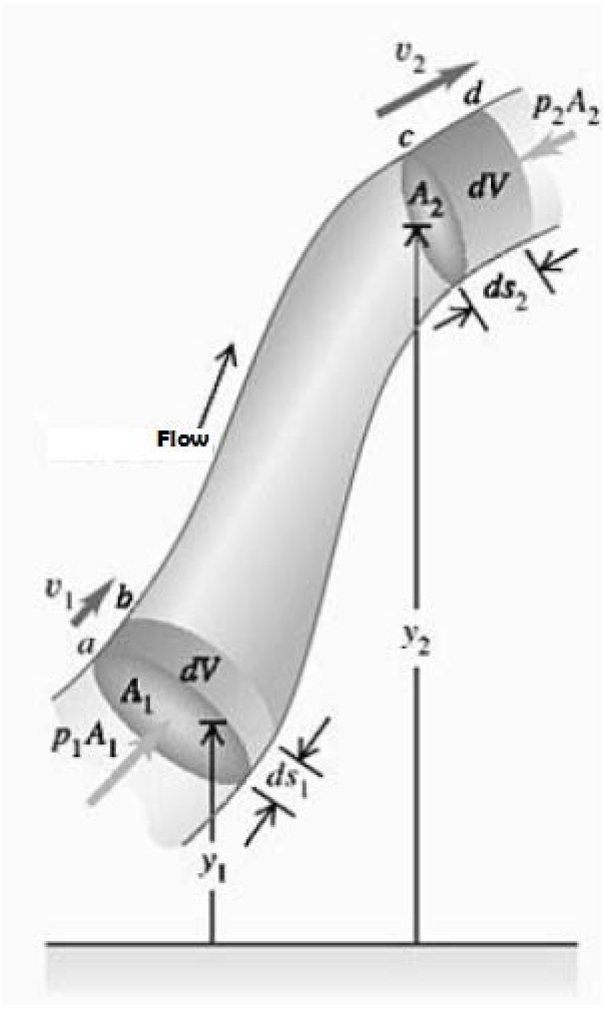

Figure 2: developed for this study

If we consider that the two regions and have different professions, and then the work done by these forces on the fluid will be:

$$dW = F_1 ds_1 - F_2 ds_2 \quad (8)$$

The force F_2 is negative because it tends to oppose the movement . How $F = p \cdot A$ then:

$$dW = p_1 . A_1 ds_1 - p_2 . A_2 ds_2 = (p_1 - p_2)\, dV. \quad (9)$$

The work dW done by non-conservative forces, according to the law of labor-power, must be equal to the variation of mechanical energy of the system.

Mechanical energy has two components: the kinetic energy (***K***) and the Energy power (**U**).

The change in kinetic energy in a time dt interval will be: $dK = \frac{m_2.(v_2)^2}{2} - \frac{m_1.(v_1)^2}{2}$. For incompressible fluids, and taking into account the continuity equation, we have:

$$dK = \frac{1}{2} p dV(v_2^2 - v_1^2) \quad (10)$$

The change in potential energy is

$$dU = dm.g(y_2 - y_1) = p.dV.g.(y_2 - y_1) \quad (11)$$

The law requires that labor-power $dW = dK + dU \Rightarrow (p_1 - p_2)dV = \frac{1}{2}\rho dV\left(v_2^2 - v_1^2\right) + \rho.dV.g.(y_2 - y_1)$ **(12)**

Eliminating, dV we have:

$$p_1 - p_2 = \frac{1}{2} p(v_2^2 - v_1^2) + p.g.(y_2 - y_1) \quad (13)$$

The Bernoulli equation establishes the variation of pressure in a fluid in motion as a function of speed variation and the time variation.

With different areas and where fluid moves with a constant flow, the pressure is greater at points where the area is smaller because the area which is smaller, the speed is higher (according to the continuity equation).

Conclusion

The use of mathematical models proposed in this paper, may determine the amount of time it had taken to drag the minerals deposited in the sweet riverbed. May also mud here configured as a minerals diversities, including iron ore and silica pave the river bottom, making it impossible once all marine life in its River.

Using Mathematical modeling can identify the mass volume (mud) in the river Trough, the bed can also be dimensioned and finally measure the impact of this mass using mathematical simulators such as:

Proposes to calculate the models the program MATLAB (Matrix Laboratory): provides a tool for symbolic manipulation, numerical calculation, creation and graphics display (including PNG) and a high-level programming language. Several examples of use are available as well as some statements of MATLAB capabilities in several models. There are versions for different platforms. MATLAB is a software designed to make calculations with matrices.

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